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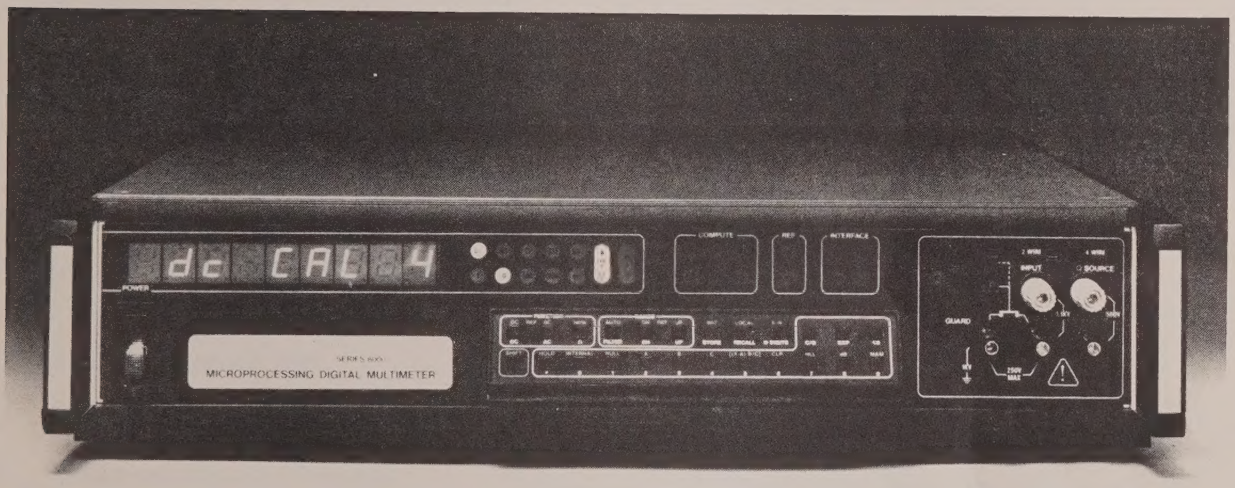
# Series 6000 Amplitude Measurement System




**The Series 6000 is a:**

- DC Voltmeter
- DC/DC Ratiometer
- AC Voltmeter
- AC/AC Ratiometer
- dB Meter
- Ohm Meter
- DC Millivoltmeter
- 2 Channel Scanner + DMM
- DC Amplifier
- Comparator Box (up to seven sorting "bins")
- Fault Alarm (single or multiple limit)
- High Speed Digitizer
- A/D Converter
- Voltage Deviation Meter
- Gain/Attenuator Meter
- Computing Multimeter
  1. Averaging
  2. Min/Max Peaks
  3. Scaling/Factoring
  4. Self Test
  5. Self Calibration
  6. Digital Offsets

**RACAL-DANA**

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## RACAL-DANA

## SERIES 6000

**Amplitude Measurement System**

The Racal-Dana Series 6000 is an instrument so unique that descriptions such as Microprocessing DVM or Smart Digital Multimeter are no longer adequate. The highly stable analog technology developed for the Racal-Dana Series 5900 and 6900 precision digital multimeters has been combined with microprocessor technology resulting in an instrument whose capabilities equal those previously available only in expensive ATE systems.

The Series 6000 Amplitude Measurement System provides new measurement capabilities to both bench and systems users of such amplitude measuring devices such as digital multimeters, A/D converters, high speed voltmeters, resistance bridges, AF voltmeters, and peak-reading voltmeters.

The Series 6000 has been designed to meet the following critical cost/performance considerations:

1. Reduce your operator costs
2. Reduce your calibration and maintenance expense
3. Reduce your equipment downtime
4. Reduce your engineering costs
5. Improve your overall measurement accuracy and capability
6. Reduce your equipment costs.

**Reduce Your Operator Costs**

Today highly skilled technicians are in great demand. Companies cannot afford the luxury of equipment that requires the use of highly skilled operators for production, R&D, or other repetitive testing. Several unique features combine in the Series 6000 to allow either faster testing, automatic testing, or use of lower skilled operators -- all designed to lower your operating costs.

1. *Easy to Use Keyboard*

   By using the technique as shown in dB example, the Series 6000 can be easily set up and operated by even an inexperienced and relatively untrained operator.

**Setup For Measuring AC Voltage In dB:**

a. Turn on power

b. Observe Auto-Test. [If "ERR" is shown - call supervisor]

c. When display shows all numbers, continue setup

d. Push AC

e. Push Filter

f. Push Shift

g. Push dB

h. Setup complete.

2. *Results of Measurement Shown in High Level Units of Measure*

   Many voltage or resistance measurements are made only to be further calculated into high level units of measure such as temperature, strain, weight, gain, attenuation, deviation, etc. By combining the features such as Null, dB, Mathematical Scaling, and Ratio, the Series 6000 will display the results of most measurements directly in the desired unit of measure. This eliminates the need for costly and time consuming operator calculations.

3. *Built-In Memory*

   Not only will the Series 6000 remember the minimum and maximum of a series of readings, but up to 9 other values may be stored for later recall. This reduces the need for logging of intermediate data.

4. *Automatic Recording Min/Max/Average*

   The Series 6000 may be operated for an unlimited time (9,999 Readings) and upon command will display the minimum and maximum readings, the average of all readings, and the number of readings taken. This eliminates the need for a full time operator for long term tests.

5. *Internal Switching*

   The Series 6000 is provided with switchable (and programmable) front and rear inputs. This allows measurements from two different locations without requiring a skilled operator to move the input connections.

**Reduce Your Calibrations and Maintenance Costs**
**And**
**Reduce Your Equipment Downtime**

The Series 6000 is built around a totally new concept of calibration and maintenance. No other digital multimeter can offer these combined features designed to reduce your equipment downtime and cut your maintenance and calibration expense. This capability can be summarized into four features:

1. *Digical* ™

   You can automatically calibrate the Series 6000 from the front panel without removing any covers. Digital correction factors are stored for most functions and ranges. You never need worry about these correction factors as they are stored in EAROM and remain valid even when power is off -- no batteries that fail or potentiometers that change. The operate/cal switch on rear panel may be sealed for safety.

   This exclusive feature reduces calibration time and expense to a minimum. When combined with the guaranteed one year specifications this means the lowest calibration expense possible.

2. *Exchangeable Cal-Module (ECM)* ™

   Most system applications require a minimum of downtime. Applications in production test, incoming inspection, QA, and R&D also require an instrument that's "on-the-job" -- not "in-for-calibration".

   The exclusive Exchangeable Cal-Module (ECM) allows "on-site" calibration of all functions and ranges ... simply replace the ECM with a recently calibrated one ... no need to send the entire unit away. Extra ECM's are available as an option.

   Using the ECM, calibration downtime can be reduced to less than 3 minutes! The Exchangeable Cal-Modules may be digitally calibrated in the calibration laboratory by insertion into a calibration test assembly or another Series 6000.

3. *Non-Volatile Calibration* ™

   Since all circuits that affect the calibration traceability are contained inside the Exchangeable Cal-Module, all other circuits may be repaired or replaced without invalidating the calibration certification. Most circuits are plug-in assemblies and can be exchanged with minimum downtime during maintenance.

   Combining the ECM and the Non-Volatile Calibration concepts, the Series 6000 will never need to leave your system or bench... not even for maintenance or calibration.

4. *Predictive Maintenance* ™

   Because of the exclusive Auto-Test/Auto-Cal feature, the Series 6000 can actually predict many common types of failures before they affect the operation or accuracy of the measurement. The Auto-Test routine compares values at 16 points within the Series 6000 to limits stored during manufacture in non-volatile read-only memory (ROM). Each of the 16 values are compared to two sets of limits. Limit set 1 is the normal limits for each value. Limit set 2 is the limits beyond which the Auto-Cal-routine cannot correct. Operation of the Auto-Test/Auto-Cal feature is described below. The combination of the ECM, Non-Volatile Calibration, and Predictive Maintenance features means the Series 6000 will reduce downtime and maintenance expense to a minimum and allow you to schedule downtime at your convenience.

**Auto-Test/Auto-Cal Routines**

This exclusive feature is activated on power up and at fixed intervals thereafter (approximately every four hours after warm up). The routine may be inhibited and/or initiated when desired. The routine compares the values at 16 points within the 6000 to predetermined limits. The following sequence illustrates the operation of this exclusive feature.

| | |
|---|---|
| Step 1. | Sets up 6000 to known conditions (i.e., 10V Range, DC Function, etc.) |
| Step 2. | Measures Value |
| Step 3. | Compares value to limit 1 |
| Step 4. | If inside limits, jumps to 9 |
| Step 5. | If outside limits, displays "ERR XX"*† |
| Step 6. | Compares value to limit 2 |
| Step 7. | If inside limits, jumps to 9 |
| Step 8. | If outside limits, locks display to "ERR XX"*†† |
| Step 9. | If inside limit 1 and 2, stores corrections necessary to bring value to nominal value |
| Step 10. | Goes to next function, Step 1. |

*Error Code defines type of error

†This temporary error message indicates the Series 6000 has been corrected and all readings will be within tolerance, however it should be scheduled for maintenance at users convenience.

††This error message indicates an out of tolerance condition in the Series 6000.

## Reduce Your Engineering Costs

### For Your Bench Applications

Your engineering costs are reduced on bench applications by eliminating many test fixtures and special set ups normally required with the conventional Digital Multimeter. Such features as software ratio, dB, and Hi/Lo limits, and "7-bin" sorting reduce your need of these extra interfaces and fixtures.

### For Your System Applications

Easy to use GPIB interface (IEEE-STD-488) with all applicable subsets implemented is designed for speed and ease of programming. With three generations of GPIB design experience, Racal-Dana engineers have provided an instrument with unprecedented speed and versatility on the IEEE bus. When combined with the High Speed Digitizer option, readings can be transferred on the bus at over 6000 readings per second.

Combining this interface with features such as the High Speed Digitizer, "7-bin" sorting, dB measurements, programmable front/rear inputs and tri-function ratio you can reduce your system design time and cost significantly.

For customers using the popular Racal-Dana Model 5900, a pin for pin interface is available to allow you to update your system to include the exclusive calibration and maintenance concepts without expensive hardware or software redesign.

## Improve Overall Measurement Accuracy and Capability

The Racal-Dana Models 5900 and 6900 (standards of the industry) offer the ultimate 5 1/2 and 6 1/2 digit Digital Multimeter accuracies. To provide better overall accuracies in the Series 6000 Racal-Dana looked outside the Digital Multimeter portion of the measurement set up for sources of error. Features were added to the Series 6000 to allow you to reduce or eliminate errors external to the Digital Multimeter.

The NULL feature allows external thermal voltages, lead resistances, or other offsets to be eliminated from the measurement, thereby improving overall accuracy. The software ratio mode allows AC/AC ratios to be made using a single AC converter thereby eliminating the effect of converter inaccuracy on many measurements. These and other features such as switchable front and rear inputs, scaling, averaging, and selectable 4 1/2- to 6 1/2- digit resolution combine to make the Series 6000 the most versatile amplitude measurement system available.

## Reduce Equipment Costs

The Series 6000 can in many applications eliminate the need for expensive extra equipment. For example, resistor sorting requires no external comparator box; High Speed Digitizer option replaces A to D converters in systems; math and dB features may replace the need for a calculator or extensive computer software.

# PERFORMANCE ON YOUR BENCH

Features:

- 0.001% DC Accuracy
- 100 Nanovolt Resolution (Option 41)
- 24 Different Ratio Configurations
- Tri-Function Ratio
- 3 Resolution Settings: 4 1/2, 5 1/2, 6 1/2 Digits
- Up to 6 DC Voltage Ranges; 4 AC Voltage Ranges
- Up to 9 Ranges of Resistance Measurement
- 3 Integration Times - Switchable
- Switchable Front/Rear Input
- Switchable AC or AC + DC Mode on True RMS AC Voltage Mode
- Choice of True RMS or Averaging AC Converter
- Switchable 3-Pole Active Filter
- High-Speed Autoranging
- Null Capability
- Full Math Capability: Display = $\frac{(X-A)B}{C}$
- Single Limit or Hi/Lo Limit Testing
- "7-BIN" Sorting
- dB Measurements: −100 dB to +100 dB Range
- Averages up to 9,999 Readings
- Up to Nine "Scratch-Pad" Memories
- Saves and Recalls Min/Max Values
- Exchangeable Cal-Module (ECM)
- Digital Calibration
- Auto-Test/Auto-Cal
- Non-Volatile Calibration Memory
- Predictive Maintenance
- Direct Measurement of Gain or Attenuation
- Direct Measurement of Gain vs Frequency
- Analog Output
- Ohms Guard for In-Circuit Resistance Measurement

## THE SERIES 6000 -- A NEW STANDARD FOR MEASUREMENT CAPABILITY

No other digital voltmeter offers the performance and features of the Series 6000.

### DC Volts

1. *100 Nanovolt Resolution.*

   The basic 6000 includes five DC ranges (0.1V, 1V, 10V, 100V, 1000V), which provide a resolution of 100 nV on the 0.1V range. Addition of Option 41 provides a resolution of 100 nanovolts on a 10 mV range.

2. *60% Overrange.*

   The 6000 provides 60% overrange capability in all functions. This means that many measurements can be made with seven-digit resolution. The 6000 provides 120% overrange on the 10 mV range (Option 41), allowing up to 22 mV to be measured with 100 nanovolt resolution.

3. *Delayed Dual-Slope.*

   To extract the fullest practical potential from the dual slope integrator design, a 200-count delay is inserted between the signal integration period and the reference integration period. This results in extremely high linearity. Coupled with a bandwidth limited null detector with extremely low noise characteristics, this exclusive Racal-Dana design assures maximum accuracy and stability for minimum cost and design capability.

4. *0.001% DC Accuracy.*

   The basic 6000 maintains ± 0.001% of full scale accuracy on its ten-volt range for 24 hours, and ± (0.001% of reading + 0.001% of full scale) for 90 days and over a 10°C temperature span.

5. *Greater Than 10,000 Megohm Input Resistance.*

   Accuracy in the 6000 is further enhanced by input impedance capability that provides less than 0.001% loading error from up to a 100 kilohm source. In addition, "kickback" current to the source has been eliminated through the use of an isolator, thus enabling measurement of capacitive sources, such as filter outputs. The input impedance does not change during any part of the reading cycle.

### DC Millivolts (Option 41)

1. *120% Overrange.*

   The 10 mV/1 ohm Extended Range Option allows measurements of low-level voltages from sources such as thermocouples, bridges, and detectors. The 120% overrange allows up to 22 millivolts to be measured with maximum resolution.

2. *100 dB Normal (Series) Mode Rejection.*

   The use of Delayed Dual-slope integration plus active input filtering assures a stable reading even with noise on the input signal. In addition, multiple readings may be averaged to provide even greater integration of noise.

### AC Volts

The Series 6000 offers the ultimate in AC measurement capability. A choice of average or True RMS converters, AC/AC ratio capabilities, display of values in dBm, and location of AC converter within the ECM are all features designed to save you money and increase your measurement expertise. Series 6000 AC features include:

1. *Broadband AC - 20 Hz to 1 MHz.*

   The Option 14 Averaging AC Converter has four AC ranges for making accurate measurements over a frequency range from 20 Hz to 1 MHz.

2. *0.04% AC Accuracy.*

   The Option 14 maintains an accuracy over a frequency range of 100 Hz to 5 KHz of ± (0.04% of reading + 0.004% of full scale) for 90 days ± 5°C.

3. *True RMS AC.*

   The Option 10, True RMS AC Converter, provides 0.1% typical accuracy over crest factors from 7 to 22. The converter operates in either the AC Mode or AC + DC Mode.

4. *Keyboard-Controlled AC or DC Coupling.*

   When equipped with Option 10, True RMS AC Converter, the AC mode or AC + DC mode may be selected by keyboard control. When used with

Option 55, this coupling mode may be programmed remotely.

5. *Two-Speed Measurement Capability.*

Depending on your measurement requirements, the 6000 provides the flexibility of two settling speeds for AC voltages. With the filter in, the input settles to within its rated accuracy in 400 msec for the Option 10 and 600 msec for the Option 14. However, with the filter out, the input settles to within its rated accuracy in 100 msec for the Option 10 and 200 msec for the Option 14.

**Ohms**

1. *Nine Ranges - 1 Ohm to 100 Megohms.*

The 6000 offers eight ranges of ohms when equipped with the Option 24 Ohms Converter. The addition of Option 41, Extended Range, provides an additional range of 1 ohmfull scale for measuring low resistance values.

2. *Four-Wire Sensing.*

The 6000 equipped with the Option 24 Ohms Converter, provides four-wire sensing. Separate current and voltage leads are available for the elimination of errors caused by input lead resistance. The "null" feature also allows lead resistance errors to be digitally corrected. The 6000 may be converted from two-wire to four-wire configuration by front panel switch. These features become particularly significant in systems applications where leads of various lengths are commonly used.

3. *0.003% Ohms Accuracy.*

The Option 24 Ohms Converter maintains an accuracy of $\pm$ (0.003% of reading + 0.001% of full scale) for 90 days ($\pm$ 5°C) on its kilohm to 1 megohm ranges. This accuracy is achieved by measuring ohms using the Ratiometric technique. This eliminates all sources of error due to reference zener diode drift with time.

4. *Unique Ohms Guard.*

The 6000 has a unique ohms guard which allows certain in-circuit ohms measurements to be made at full accuracy. The measurement of resistor networks (e.g., strain bridges) without the need to disassemble individual resistors or to calculate their values from a series of measurements is now possible. The ohms guard is particularly effective in preventing triboelectric errors in systems applications where long input leads are utilized.

5. *Microhm Resolution.*

When equipped with Options 24 and 41, the 6000 provides 10 $\mu$ohms resolution. A resolution of 1 ppm of range is provided on all other ohms ranges when in the 6 1/2-digit mode.

**Tri-Function Ratio**

The Series 6000 opens the door to new measurement methods with its exclusive Tri-Function Ratio. Over 24 different ratio configurations are available. Add to this 10 reference ranges and 19 signal ranges and you have capabilities equalled only be expensive computer-controlled ATE systems.

The 6000 Tri-Function Ratio provides three direct reading ratio function modes:

1. *Math Ratio.*

Math ratio is provided as a standard feature on all units. It allows the operator to make the measurement:

$$R = \frac{X}{C}$$

where: R = displayed reading
X = measured data
C = stored reference value

The Value C may be either a value entered by keyboard or a previous reading stored in memory.

Combined with switchable front and rear inputs, this function allows higher speed ratio measurements for those applications where the external reference voltage is relatively stable.

2. *Automatic Software Ratio.*

An exclusive, standard feature on the Series 6000, this ratio function offers total isolation between the signal and reference inputs and provides multiple ranges on both signal and reference inputs. With the addition of either an Option 14 or Option 10 AC Converter, the 6000 accepts both AC or DC reference inputs and AC or DC signal inputs. Since both signal and reference inputs are measured by the same circuitry, this ratio function offers ratio accuracies as great as ± 3 digits for many measurements. Exclusive features available with this ratio function include:

- Accuracies to ± 3 digits
- 1000V reference to signal isolation
- Direct readout in real ratio with scientific notation
- Total guarding of both signal and reference inputs

3. *Hardware Ratio.*

For those applications that require simultaneous monitoring of reference and signal inputs, these functions are offered as options. Option 34 provides four-wire DC/DC, AC/DC, Ohms/DC ratios. Option 10 provides four ranges of AC reference input for AC/AC, AC/DC, Ohms/AC ratios. Ratio is measured directly by the analog to digital converter circuitry.

**dB Readings**

1. *–100 dB to +100 dB Range.*

When the dB function is selected the 6000 provides a full ± 100 dB dynamic range, limited only by the 100 nV to 1000V measurement range.

2. *Variable Reference.*

On power-up, the 6000 automatically measures 0 dB = 1 mv into 600 ohms. Other impedance values may be entered directly from the keyboard (or remotely) for 50 ohms, 75 ohms, etc., reference.

3. *Full Function.*

The 6000 will display dB indication on all signal functions: DC volts, AC volts, and ohms.

4. *0.1 dB Resolution.*

Resolution of 0.1 dB is maintained over entire ± 100 dB range.

**Gain/Attenuation.**

By combining the ratio and dB functions, the Series 6000 measures directly in decibals of gain or attenuation.

1. *AC or DC Circuits.*

Either AC or DC circuits may be tested by selecting the appropriate voltage functions.

2. *± 100 dB Range.*

Gains from 0 to ± 100 dB may be measured directly by the 6000.

3. *0.1 dB Resolution.*

For critical testing, the 0.1 dB resolution of the 6000 offers superior resolution to many gain measuring systems now available.

4. *Gain/Attenuation Vs. Frequency.*

Frequency response of active or passive circuits may be measured directly in ± dB from the gain/attenuation at reference frequency by using the scaling capabilities of the 6000.

**Computing Functions**

The Series 6000 offers as standard features computational functions not even available at extra cost on other microprocessing DVM's.

1. *Null.*

The null function is designed to allow rapid "zeroing" of displayed value. When the null function is inserted, the displayed value is:

$$R = X - N$$

where: R = displayed value
X = measured value
N = value stored in null

The currently displayed reading is stored as null value when null is inserted. Simply press "shift", "null" keys to insert/disengage null. Values other than current reading may also be stored as null value, if desired. The superior accuracy of the Series 6000 may be transferred to the point of measurement by using the null function to eliminate the effects of lead resistance or thermal effects of leads and connections.

2. *Full Math Scaling.*

$$R = \frac{(X-A)B}{C}$$

where: R = displayed value
X = measured value
A = value stored in Memory A
B = value stored in Memory B
C = value stored in Memory C

This function may be used to convert the measured data into a variety of desired answers. For example:

a. Scale $\frac{X-A}{C}$

A common application of scaling is to convert the resistance of a temperature-sensitive resistor to temperature in °C. For example, the operating characteristics may be:

Range: −55°C to +250°C
Resistance: 1000Ω at 25°C
Temperature Coefficient: +5900 ppm/°C

This resistor changes linearly with temperature.

To scale this resistance to °C you must find the proper values for A and C since:

$$\text{Reading in } ^\circ C = \frac{X-A}{C}$$

where, X = present resistance reading
A = resistance value at 0°C
C = scale factor based on T.C. of resistor.

Two easy reference points are 25°C and 0°C. Two equations are required to find the unknowns of A and C.

$$\text{Eq. 1: } 25^\circ C = \frac{1000^* - A}{C}$$

*resistance at 25°C

$$\text{Eq. 2: } 0^\circ C = \frac{852.5^{**} - A}{C}$$

**calculated resistance at 0°C
1000Ω − (5900ppm X 25) = 852.5Ω
Hence, A = 852.5

$$\text{Eq. 1: } 25^\circ C = \frac{1000 - 852.5}{C}$$

$$C = \frac{1000 - 852.5}{25}$$

$$C = 5.9$$

You know enter values calculated for Memorys A and C, assert full-math function, and your readings are now in °C.

Other scaling applications may be handled just as easily.

b. % Deviation

$$\% = \frac{X-Y}{Y} \times 100$$

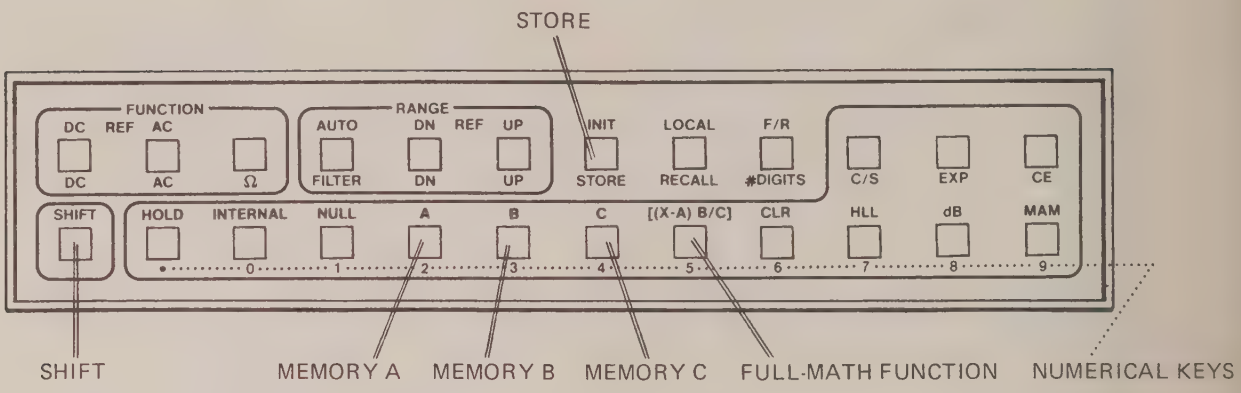
Simply store the value "Y" in memory locations "A" and "C", store "100" in memory location "B" and assert full-math function. The Series 6000 now displays % deviation of measurements from value "Y". You can quickly check the tolerance of resistors, regulation of power supplies, or other tolerances directly in percentage. Your incoming inspection tests, calibration testing, or production testing is greatly simplified when you use this feature.

c. Offset

$$X - A$$

While the null function is designed for offset operations, the full-math function may be used to provide an offset reading. Since the stored value "A" may be either positive or negative, the offset may be either added or subtracted from the measurement.

## HOW TO USE FULL-MATH FUNCTION




To Store Value in Memory:

1. Key value to be stored into display by pressing numerical keys.

2. Press store.

3. Press memory location (A, B or C).

To store a currently displayed reading, simply press "store" and memory location key.

To Assert Full-Math Function

1. Press "shift".

2. Press "$\frac{(X-A)B}{C}$"

Caution: If any memory location is not being used, press "shift", "CLR", and memory location key to erase any previously stored value.

d. Transducer Scaling

$$\frac{[(X-Y)-A]B}{C}$$

The Series 6000 may be used to scale the output of load cells, pressure transducers, or other transducers by combining the null and full-math functions. The formula $\frac{[(X-Y)-A]B}{C}$ applies where:

- X = measured output
- Y = value stored in null (measured output of transducer with zero weight)
- A = stored tare weight
- C = measured output of transducer with full scale weight/pressure after factoring with "Y" and "A"
- B = constant needed to convert to pounds, PSI, etc.

To check linearity of transducer on a 0 to 100% scale simply store 100 into memory location B.

3. *Limit Testing (HLL).*

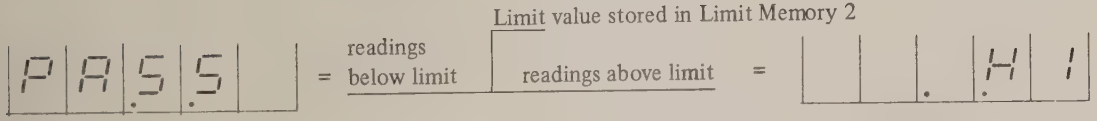
The HLL function may be used for either go/no go testing or for sorting operations. When combined with full-math function, limits may be stored in % (i.e., −1%, +1%) or engineering units.

a. Hi/Lo Limits

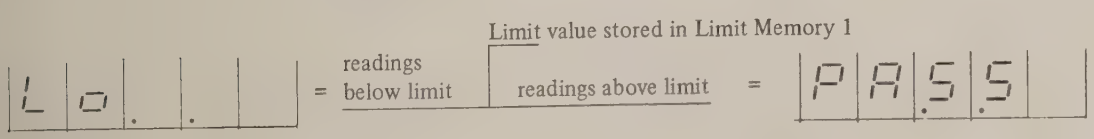
The hi/lo limit mode may be used for single or dual limit testing by storing values in either Limit Memory 1, Limit Memory 2, or both, and asserting HLL function.

The following charts illustrate the operation and displayed readings for this function when used for Hi/Lo limits.

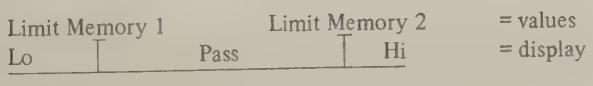
High Limit




Low Limit

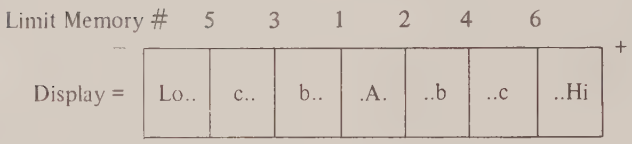



Dual Limits



b. "7-Bin" Sorting.

The HLL functions contain six Limit Memory locations (Limit Memories 1 through 6). When values are stored in more than Limit Memories 1 and 2, the Series 6000 automatically converts the HLL functions to a "sorting bin" operation. The chart below shows the displayed indication when the HLL function is being used for sorting operation: The vertical lines represent the values stored in Limit Memories. The letters are displayed as shown for measured values between each limit.




Any number of bins from 3 to 7 may be established by storing values into the appropriate Limit Memory:

4. *Min/Avg/Max (MAM).*

This function may be used to achieve several measurements. When asserted, the Series 6000 continually updates and stores the minimum and maximum reading taken. In addition, an average of all readings taken and the total number of readings taken are stored. Each of these four values may be displayed when desired. Typical uses of this function include storing and recalling + and − peak readings; digital averaging to achieve higher noise immunity; capturing average value of signal with poor short-term stability; and power-line monitoring. Combined with Hi/Lo limit mode this function allows the Series 6000 to monitor and alarm when out-of-tolerance conditions exist. Highest and lowest measured values may be stored and displayed upon command.

**Plus Many Other Features . . . . .**

- *Switchable 3-pole Active Filter* - The 6000 provides Delayed Dual-slope integration for optimum rejection of line frequency noise plus a switchable 3-pole active filter for broadband noise rejection. This combination gives unequaled common and normal (series) noise rejection.

- *Three Keyboard-Controlled Integration Times* - 1 2/3 ms, 16 2/3 ms, 100 ms signal integration times are selectable from the keyboard (2 ms, 20 ms, 100 ms for 50 Hz units). These allow the measurement speed to be optimized for the resolution and noise rejection desired.

- *Three Keyboard-Controlled Resolution Modes* - The 6000 may be set for 4 1/2, 5 1/2, or 6 1/2-digit display mode. This allows you to eliminate unwanted digits when measuring inprecise signals.

- *High-Speed Autoranging* - Most voltages will be measured with a maximum of two range changes. This reduces your "wait-time" when using autorange.

- *Up to 9 "Scratch-Pad" Memories* - When the full-function math or HLL functions are not being used the memory locations "A", "B", "C", and Limit Memories 1 through 6 may be used to store readings for recall and evaluation or recording.

- *Analog Output* - A scaled voltage output is available for driving a strip chart recorder or for using as a precise voltage source.

- *Switchable Front and Rear Inputs* - Designed especially for system applications, this feature is also useful for many applications where measurements are desired from two locations.

- *Externally Triggered Readings* - Readings may be externally triggered for your applications requiring precise timing of integration period. This is a standard feature of all Model 6000's, and does not require the purchase of programming or other options.

- *Fully-Guarded Operation* - No need to buy extra cost isolator options when selecting the 6000. All Series 6000's provide full guarding on both front and rear inputs.

- *Switchable Input Configuration* - The Series 6000 provides front panel switches for 2-wire ohms, and guard-to-ground operation. This eliminates time-consuming and potentially dangerous shorting links from front panel inputs.

# PERFORMANCE IN YOUR SYSTEM

Features: All features shown for bench operation plus,

- Over 34,000 Readings per Second (Option 03)
- Full GPIB (IEEE-STD-488) (IEC) Interface
- Pin for Pin Model 5900 Interface
- High-Speed 12 Bit Binary Parallel Interface
- High-Speed Digitizer in addition to Low-Speed Digitizer
- Fully Isolated Operation
- Five Programmable Integration Times
- Up to 6000 Reading/Sec over GPIB Interface
- Six Trigger Modes
- Keyboard Lock-out
- Display Lock-out
- Auto-Test/Auto-Cal Upon Command
- Three Output Formats
- GPIB Address Displayed in Command
- Full Annunciation of Programmed Operation
- Built-in Automatic Time-outs

**Systems Performance Without Equal . . . . .**

For a price less than you would expect to pay for the traditional systems DVM, you can now own the incomparable Series 6000. Designed from customer inputs gained during Racal-Dana's 10 years as the leading systems DVM manufacturer, the 6000 offers the system designer all of the features shown on the previous pages plus many features provided exclusively for system applications.

**Over 34,000 Readings Per Second**

*(Options 03 or 03SH)*

When equipped with one of the High-Speed Digitizer Options, the Series 6000 actually provides two separate and parallel analog-to-digital converters. The Delayed Dual-Slope converter provides high resolution and noise rejection while a successive-approximation converter provides reading rates of over 34,000 readings per second with 3 1/2-digit resolution (12-bit binary output).

**Sample and Hold** (See figure 1)

*(Option 03SH)*

For those applications that require precise timing of measurement or extremely short sample time, a sample and hold version of the High-Speed Digitizer may be added to the Series 6000. In addition to Sample and Hold the Option 03SH provides an adjustable delay circuit to allow the aperature point to be delayed to compensate for system settling time. Option 03SH also provides a wide bandpass (1 MHz), fast settling time (5 $\mu$s) input.

**Two Independent Digital Outputs**

When either Options 03 or 03SH are installed, the Series 6000 provides a 12-bit parallel binary output. In addition, Option 55 (GPIB, IEEE-STD-488) or Option 59 (BCD) may be added for output of high resolution data.

**GPIB (IEEE-STD-488-1975) Interface**

This unique "3rd Generation" IEEE interface provides full compatability to most IEEE-STD-488 subsets. Racal-Dana's exclusive design allows readings to be transferred over the bus at rates of over 6,000 readings per second!

All keyboard functions and controls may be programmed with this interface. Implementation of RL2 subset allows full lockout of keyboard or local operation while connected to bus.

Upon keyboard or remote command, the address of the Series 6000 may be displayed.

**Parallel BCD Interface (Option 59)**

Designed for those presently using the Racal-Dana (formerly Dana Laboratories) Model 5900 in your systems, Option 59 provides a pin for pin interface so that the Series 6000 may be added to your system without hardware or software redesign.

**Fully Isolated Operation**

Both the GPIB and BCD interfaces provide full isolation between the analog and digital circuitry.

**Full Annunciation**

The Series 6000 provides full annunciation of all programmed conditions for ease of software development. When your system is operating, the readout display may be blanked while still maintaining annunciation of programmed conditions.

**Automatic Timeouts**

When timeouts are programmed, the Series 6000 automatically inserts the proper timeouts to prevent first reading errors due to instrument settling times. These timeouts vary from a few milliseconds to 500 ms, depending on functions, range and filter conditions. The 6000 also inhibits output during autorange to assure only correct readings are available to your system.

**Five Integration Times**

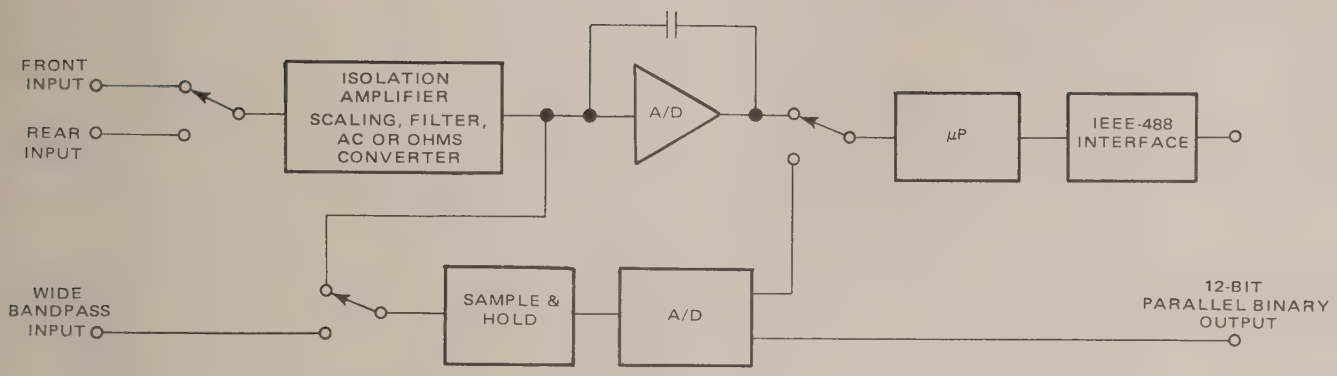
Under remote control the 6000 provides a selection of 5 integration times from 1 2/3 ms to 100 ms, plus the 29 $\mu$s High-Speed Digitizer Option. This versatility assures a read rate/resolution combination to match your most demanding applications.

**Six Trigger Modes**

The Series 6000 with Option 55 offers six programmable trigger modes. The reading may be triggered internally, externally, or by software command. In addition, the High-Speed Digitizer (Option 03SH) may be triggered internally, externally, externally with Sample and Hold, or externally with adjustable delay.

**Auto-Test/Auto-Cal On Command**

This exclusive feature may be inhibited and performed only when commanded by your controller. Of course, an auto-test/auto-cal routine may be performed any time you desire to assure the ultimate accuracy for your system.




BLOCK DIAGRAM OF SERIES 6000 WITH OPTION 03SH INSTALLED

Figure 1

# SPECIFICATIONS

## DC VOLTS
## (Included In Basic Instrument)

**Ranges:** ± .100000, ± 1.00000, ± 10.0000
± 100.000, ± 1000.00
(10 mV - with Option 41)

**Resolution:** 0.001% Range on 5 1/2 Digit Mode
0.0001% Range on 6 1/2 Digit Mode

**Overrange:** 60% except 1000V Range 1100V DC, 1500 V PK AC

**Maximum Input Voltage:** 1100V DC or 1500V Peak AC All Ranges

**Accuracy:** 5 1/2 digit mode; after Auto-Cal
± % Input ± #Digits
T.C.=(ppm of Input ± #Digits)/°C

| Range | 24 Hours 23°C ± 1°C | | 90 Days 23°C ± 5°C | | 1 Year 23°C ± 5°C | | Temperature Coefficient 0°C to 50°C | |
|---|---|---|---|---|---|---|---|---|
| | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits |
| 10 Volts | —— | 1 | 0.001% | 1 | 0.003% | 1 | 1.5 ppm | .05 |
| 1, 100, 1000 Volt | 0.001% | 1 | 0.002% | 1 | 0.004% | 1 | 3 ppm | .1 |
| 100 mV | 0.002% | 5 | 0.003% | 5 | 0.005% | 5 | 4 ppm | .5 |
| 10 mV | See Extended Range Option | | | | | | | |

**Input Impedances:** .1V, 1V, 10V Ranges > 10,000MΩ
100V, 1KV Ranges 10MΩ

**Input Bias Current:** ≤ 30 pA at 23°C

**Input Bias Current TC:** Doubles Every 10°C

**Normal Mode Rejection:**
Unfiltered: 48 dB at Multiples of 60 Hz
Filtered: 100 dB at 60 Hz

**Settling Time:**
Unfiltered: Settles to within 0.01% at digitizer input in 5 mS with 10KΩ Source, 10 mS on 100V Range

Filtered: Settles to within 0.01% at digitizer input in 450 mS with 10KΩ Source, on all Ranges

**Common Mode Rejection:**
With 100Ω Unbalance in either Lead

Unfiltered: 140 dB DC
120 dB at 61 Hz and Below Plus an Additional 54 dB at Harmonics of 60 Hz

Filtered: 140 dB DC to 61 Hz
126 dB 61 Hz to 100 KHz

## OHMS (Option 24)

| | |
|---|---|
| **Ranges:** | 1.00000Ω with Option 41<br>10.0000Ω, 100.000Ω, 1.00000KΩ,<br>10.0000KΩ, 100.000KΩ,<br>1.00000MΩ, 10.0000MΩ,<br>100.000MΩ. |
| **Resolution:** | 0.001% F.S. in all Ranges<br>5 1/2 Digit Mode<br>0.0001% F.S. in all Ranges<br>6 1/2 Digit Mode |
| **Overrange:** | 60% on all Ranges |
| **Maximum Input Voltage:** | ± 350V Peak on 1Ω Range<br>± 500V Peak on 10Ω–100MΩ |
| **Measurement Scheme:** | Modified 4-Wire |
| **Accuracy:** | 5 1/2 digit mode; after Auto-Cal<br>± (% Input + # Digits) |

| Range | 24 Hours 23°C ± 1°C | | 90 Days 23°C ± 5°C | | 1 Year 23°C ± 5°C | | Temperature Coefficient 0°C to 50°C (± % Input ± # Digits)/°C | |
|---|---|---|---|---|---|---|---|---|
| | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits |
| 1Ω | See Extended Range Option | | | | | | | |
| 10Ω | 0.003% | 5 | 0.005% | 5 | 0.006% | 5 | 0.0008% | 0.5 |
| 100Ω - 1 Megohm | 0.002% | 1 | 0.003% | 1 | 0.004% | 1 | 0.0007% | 0.1 |
| 10 Megohm | 0.01% | 1 | 0.03% | 1 | 0.04% | 1 | 0.003% | 0.1 |
| 100 Megohm | 0.02% | 1 | 0.03% | 1 | 0.04% | 1 | 0.005% | 0.1 |

| | |
|---|---|
| **Open Circuit Voltage:** | 1Ω Range 24V Max<br>10Ω to 1KΩ 8V Max<br>10KΩ to 100MΩ 24 Max |
| **Current Through Unknown:** | 1Ω, 10Ω, 100Ω Ranges 10 mA<br>1KΩ, 10KΩ Ranges 1 mA<br>100KΩ Range 100μA<br>1MΩ Range 10μA<br>10MΩ Range 1μA<br>100MΩ Range 100 nA |
| **Normal Mode Rejection:** | |
| Unfiltered | 48 dB at Multiples of 60 Hz |
| Filtered | 48 dB at 59 Hz increasing at 24 dB per octave plus 48 dB at multiples of 60 Hz to a maximum of 100 dB. |
| **Settling Time:** | |
| To Rated Accuracy | 1Ω Range 1 Second<br>10Ω to 10MΩ Ranges 30 mSec<br>100MΩ Range 300 mSec |
| **Ohms Guard:** | Use "Analog Out" Low on Rear Panel when in Ohms |

## EXTENDED RANGE (OPTION 41)

**Ranges:** ± 10.0000 mV, 1.00000Ω*

## MILLIVOLT RANGE

**Resolution:** .001% F.S. (100 nV)

**Overrange:** 120% (Reads 22mV input with no degradation of accuracy)

**Accuracy:** 5 1/2 digit mode; ① After Auto-Cal

| Range | 24 Hour 23°C + 1°C | | 90 Days 23°C ± 5°C | | 1 Year 23°C ± 5°C | | Temperature Coefficient ② 0°C to 50°C (± % Input ± # Digits)/°C | |
|---|---|---|---|---|---|---|---|---|
| | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits |
| 10 mV | 0.005% | 5 | 0.008% | 5 | 0.01% | 5 | 0.002% | 0.5 |

① With source resistance ≤ 1KΩ and input zeroed by pushing NULL with shorted input leads.
② With Auto-Cal after temperature change.

**Maximum Input Voltage:** 350V DC or 250V RMS

**Input Impedance:** 100 MΩ minimum shunted by 4.8 KΩ in series with 1.5 μF

**Input Bias Current:** 300 pA Typical at 23°C

**Normal Mode Rejection:** Same as DC Function

**Common Mode Rejection:** Same as DC Function

**Settling Time, Unfiltered:** Settles to within 0.01% at digitizer input in 850 mSec with up to 10KΩ source resistance.

## * 1 OHM RANGE (Option 24 Ohms Converter Must Be Installed)

**Resolution:** .001% F.S. (10μΩ)

**Overrange:**

**Maximum Input Voltage:** ± 350V Peak

**Accuracy:** 5 1/2 digit mode; after Auto-Cal [1]

| Range | 24 Hours 23°C ± 1°C | | 90 Days 23°C ± 5°C | | 1 Year 23°C ± 5°C | | Temperature Coefficient 0°C to 50°C (± % Input ± # Digits)/°C | |
|---|---|---|---|---|---|---|---|---|
| | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits | % Input | No. Digits |
| 1.00000Ω | 0.015% | 20 | 0.02% | 20 | 0.03% | 20 | 0.002% | 2 |

① Accuracy specified after zeroing input by using NULL with input shorted.

## AC VOLTS TRUE RMS (Option 10)

**Ranges:** 1.00000V, 10.0000V RMS
100.000V, 1000.00V RMS

**Resolution:** 0.001% of Range

**Maximum Input Voltage:** 1000V RMS or 1500V Peak, decreasing to 50V RMS at 300 KHz. $1.5 \times 10^7/(V)(Hz)$ max. any Range.

**Settling Time:** Settles to within 0.1% of Range:
Zero to F.S.
"Filter" Out 80 mSec
"Filter" In 350 mSec
F.S. to 10% F.S. Settles to within 0.1% Range
"Filter" Out 100 mSec
"Filter" In 400 mSec

**Input Impedance:** 1MΩ in series with .22 μF, shunted by less than 200 pF to common. In DC coupled mode the .22 μF capacitor is shorted.

**Common Mode Rejection:**

| Range | CMRR |
|---|---|
| 1V | 120 dB |
| 10V | 100 dB |
| 100V | 80 dB |
| 1000V | 60 dB |

100Ω Unbalance either lead. DC to 60 Hz

**Accuracy:**

24 Hrs. 25°C ± 1°C
After Auto Cal
Sinewave Input, $V_{IN} \leq 500V$
0.1% F.S. $\leq V_{IN} \leq$ 160% F.S.
For $V_{IN} > 500V$ add 0.1% of RDG to specification

20 Hz - 30 Hz (Filt.) ± (0.5% RDG + 0.05% F.S.)
30 Hz - 50 Hz (Filt.) ± (0.2% RDG + 0.05% F.S.)
50 Hz - 100 Hz (Filt.) ± (0.1% RDG + 0.05% F.S.)
100 Hz - 20 KHz (Filt.) ± (0.06% RDG + 0.05% F.S.)
200 Hz - 20 KHz (No Filt.) ± (0.06% RDG + 0.05% F.S.)
20 KHz - 50 KHz (Both) ± (0.09% RDG + 0.1% F.S.)
50 KHz - 100 KHz (Both) ± (0.38% RDG + 0.18% F.S.)
100 KHz - 300 KHz (Both)
10V, 100V, 1000V Ranges ± (3% RDG + 0.5% F.S.)
1V Range ± (5% RDG + 1% F.S.)

## AC VOLTS continued

90 Days 25°C ± 5°C
Same Conditions as Above

20 Hz - 30 Hz (Filt.) ± (0.5% RDG + 0.06% F.S.)
30 Hz - 50 Hz (Filt.) ± (0.2% RDG + 0.06% F.S.)
50 Hz - 100 Hz (Filt.) ± (0.1% RDG + 0.06% F.S.)
100 Hz - 20 KHz (Filt.) ± (0.07% RDG + 0.06% F.S.)
200 Hz - 20 KHz (No Filt.) ± (0.07% RDG + 0.06% F.S.)
20 KHz - 50 KHz (Both) ± (0.1% RDG + 0.1% F.S.)
50 KHz - 100 KHz (Both) ± (0.4% RDG + 0.2% F.S.)
100 KHz - 300 KHz (Both)
10V, 100V, 1000V Ranges ± (3% RDG + 0.5% F.S.)
1V Range ± (5% RDG + 1% F.S.)

6 Mos. 25°C ± 5°C
Same Conditions as Above

20 Hz - 30 Hz (Filt.) ± (0.52% RDG + 0.07% F.S.)
30 Hz - 50 Hz (Filt.) ± (0.22% RDG + 0.07% F.S.)
50 Hz - 100 Hz (Filt.) ± (0.12% RDG + 0.07% F.S.)
100 Hz - 20 KHz (Filt.) ± (0.08% RDG + 0.07% F.S.)
20 KHz - 50 KHz (Both) ± (0.11% RDG + 0.11% F.S.)
50 KHz - 100 KHz (Both) ± (0.42% RDG + 0.22% F.S.)
100 KHz - 300 KHz (Both)
10V, 100V, 1000V Ranges ± (4% RDG + 0.6% F.S.)
1V Range ± (6% RDG + 1.1% F.S.)

**Temperature Coefficient:** ± (0.004% RDG + 0.005% F.S.)/°C

Crest Factor 7:1 at full scale
$7 \times \sqrt{\frac{F.S.}{V_{IN}}}$ for other voltages

## AC VOLTS AVERAGING (Option 14)

| | |
|---|---|
| **Ranges:** | 1.00000V, 10.0000V, 100.000V, 1000.00V |
| **Resolution:** | .001% of Range |
| **Maximum Input Voltage:** | 1000V RMS or 1500V Peak, decreasing to 20V RMS at 1 MHz. $2x10^7$(V) (Hz) max any Range. |
| **Settling Time:** | Settles to within rated accuracy of range: |
| Zero to F.S. | |
| "Filter" Out | 200 msec |
| "Filter" In | 600 msec |
| F.S. to 10% F.S. | |
| "Filter" Out | 200 msec |
| "Filter" In | 600 msec |
| **Input Impedance:** | 1MΩ in series with .22μF, shunted by less than 100 pF to common. |
| **Common Mode Rejection:** | Range CMRR |
| 100Ω Unbalance either lead. DC to 60 Hz | 1V 120 dB<br>10V 100 dB<br>100V 80 dB<br>1000V 60 dB |
| **Accuracy:** | |
| 24 Hrs. 23°C ± 1°C | 20 Hz – 30 Hz (Filt.) ±(.3% rdg + .002% F.S.) |
| After Auto Cal Sinewave Input, $V_{IN} \leq 500V$ 0.1% F.S. $\leq V_{IN} \leq$ 160% F.S. For $V_{IN} > 500V$ add 0.1% of RDG to specification | 30 Hz – 50 Hz (Filt.) ±(.2% rdg + .002% F.S.)<br>50 Hz – 100 Hz (Filt.) ±(.05% rdg + .002% F.S.)<br>100 Hz – 5 KHz (Filt.) ±(.03% rdg + .002% F.S.)<br>300 Hz – 5 KHz (No Filt.) ±(.03% rdg + .002% F.S.)<br>5 KHz – 50 KHz (Both) ±(.04% rdg + .005% F.S.)<br>50 KHz – 100 KHz (Both) ±(.05% rdg + .01% F.S.)<br>100 KHz – 300 KHz (Both) ±(.6% rdg + .02% F.S.)<br>300 KHz – 1 MHz (Both) ±(2.5% rdg + .07% F.S.) |
| 90 Days 23°C ± 5°C Same Conditions as Above | Add ±(.01% rdg + .002% F.S.) to the 24 hour specification |

## AC VOLTS continued

| | |
|---|---|
| 6 Mos. 23°C ± 5°C Same Conditions as Above | Add ±(.02% rdg + .003% F.S.) to the 24 hour specification |
| **Temperature Coefficient:** | 50 Hz to 20 KHz (Filt.) ±(.003% rdg + .0005% F.S.)/°C<br>20 Hz to 100 KHz (Both) ±(.005% rdg + .002% F.S.)/°C<br>100 KHz to 1 MHz (Both) ±(.02% rdg + .01% F.S.)/°C |

## HIGH/LOW LIMIT (HLL)

| | |
|---|---|
| Number of Limits Available: | Six |
| Limit Range: | $\pm 9999.99 \times 10^{\pm 9}$ |
| Display, | |
| Single Limit: | Pass, Hi or Lo, Pass |
| Dual Limit: | Lo, Pass, Hi |
| Multiple Limits: | Lo, c..,b..,.A.,..b,..c,Hi |
| Accuracy: | Same as function selected |
| Calculation Time: (Per Reading) | Approximately 8 mS maximum<br>Approximately 2 mS single limit |

## MIN/AVG/MAX

| | |
|---|---|
| Maximum Readings Without Error: | |
| Average: | 9,999 readings |
| Minimum: | No limit |
| Maximum: | No limit |
| Values Displayed Upon Recall: | |
| Avg: | Average value of all readings taken |
| Min: | Most negative reading taken |
| Max: | Most positive reading taken |
| Accuracy: | Same as function selected |
| Calculation Time: | Approximately 10 mS per reading |

## FULL-MATH SCALING

| | |
|---|---|
| Formula: | $R = \frac{(X-A)B}{C}$ |
| Memory Locations: | Three - A, B, C |
| Min Constant Value: | $\pm .000001 \times 10^{-9}$ |
| Max Constant Value: | $\pm 9999.99 \times 10^{+9}$ |
| Calculation Accuracy: | $\pm$ 1 digit in displayed answer |
| Calculation Time: | Approximately 35 mS per reading |

## dB FUNCTION

| | |
|---|---|
| Unit of Measure: | dBm, dBV, dB of ratio |
| Reference: | |
| dBm: | 0dBm = 1mw into 600Ω on turn-on. May be programmed by keyboard or GPIB interface to any ohms value between 1 ohm and $9999.99 \times 10^{9}$ ohms. |
| dBV: | 0dBV = 1.0 Volt |
| dB of Ratio: | See Gain/Attenuation function |
| Range: | −80 dBm to +60 dBm (600Ω reference)<br>−100 dBV to +60 dBV<br>$\pm$ 100 dB of ratio |
| Resolution: | 0.1 dBm, dBV, or dB |
| Accuracy: | $\pm$ 0.1 dBm, dBV, or dB + accuracy of function selected |
| Calculation Time: | Approximately 25 mS per reading |

## HIGH SPEED DIGITIZER (OPTION 03)

| | |
|---|---|
| Range: | May be used with any function and range |
| Input: | Normal signal input terminals |
| Output: | 12 - bit binary (parallel) GPIB (IEEE-STD-488) when Option 55 is installed |
| Resolution: | 0.1% of range |
| Accuracy: | 24 Hours 23°C $\pm$ 1°C<br>$\pm$ (.05% reading $\pm$ 0.15% range)<br>+ function error*<br>1 Year 23°C $\pm$ 5°C<br>$\pm$ (.35% reading $\pm$ 0.35% range)<br>+ function error*<br>*Function error may be disregarded on all but AC function |
| Settling Time: | Same as function selected |
| Temperature Coefficient: | $\pm$ .015% reading $\pm$ .01% range/°C |

## HIGH SPEED DIGITIZER WITH SAMPLE AND HOLD (OPTION 03SH)

| | |
|---|---|
| **Inputs:** | |
| **Input 1:** | Normal signal terminals |
| **Input 2:** | Wide bandpass input on rear connector |
| **Input Specifications:** | |
| **Input 1:** | May be used with any function and range |
| **Input 2:** | |
| **Bandpass:** | DC - 1 MHz (3dB) |
| **Settling Time:** | 6μS to 0.5% of final value |
| **(20V Step):** | (1K Ohm source impedance) |
| **Input Range:** | ± 20V |
| **Max Input:** | 100V DC or Peak AC |
| **Input Resistance:** | ≥ 100 Kilohms |
| **Adjustable Delay:** | 2μS to 20μS (potentiometer adj.) |
| **Programmable Read Rate: (Internal Trigger)** | From approx. 80 readings/second to 6000 readings/second in 255 steps |
| **No Delay:** | 240 Nanoseconds ± 50 nS |
| **Delayed:** | 240 nS ± 50 nS + adjustable delay |
| **Digitizing Time:** | 29μS |

## MAX CONTINUOUS READING RATES (100% OF RANGE READING, ALL FUNCTION & RANGES)

Keyboard Control

| #Digits / Condition | HSD | 4 1/2 | 5 1/2 | 6 1/2 |
|---|---|---|---|---|
| Internal Trigger | 200 | 5 | 4 | 2 |
| External Trigger | 34,000 | 5 | 4 | 2 |

Under System Control

| #Digits / Condition | HSD | 4 1/2 | | 5 1/2 | | 6 1/2 |
|---|---|---|---|---|---|---|
| Integration Time | —— | 1.67mS | 4.0mS | 16.67mS | 40 mS | 100 mS |
| Internal Trigger | 6000 | 55 | 44 | 21 | 11 | 4 |
| External Trigger | 34,000 | 55 | 44 | 21 | 11 | 4 |

Notes:
1. Readings above 100% of Range at slightly lower rates.
2. Readings below 100% of Range at higher rates.
3. Rates are for primary voltage or resistance measurements only and do not include processing time for high level measurements or computations.

## GAIN / ATTENUATION $\left(20 \text{ LOG } \frac{V_1}{V_2}\right)$

| | |
|---|---|
| **Range:** | ± 100 dB |
| **Resolution:** | 0.1 dB |
| **DC Accuracy:** | ± 0.2 dB ($V_1$, $V_2 \geq$ 10% of Measurement Range |
| **AC Accuracy:** | 100 Hz to 20 KHz<br>± 1.1 dB ($V_1$, $V_2 \geq$ 10% of Measurement Range<br>50 Hz to 50 KHz<br>± 2.0 dB ($V_1$, $V_2 \geq$ 10% of Measurement Range |
| **Functions Used:** | AC and AC Reference or DC and DC Reference, dB. |
| **Max Input Range to Circuit Under Test:** | ± 10μV to ± 1000V DC;<br>1.0 mV to 1000V AC |
| **Max Output Range from Circuit Under Test:** | ± 10μV to ± 1000V DC;<br>1.0 mV to 1000V AC |
| **Connections:** | $V_1$ = Front input terminals*<br>$V_2$ = Rear input terminals* |

*Inputs may be reversed using Front/Rear Input programming by keyboard or remotely.

## TRI-FUNCTION RATIO MATH RATIO $\left(R = \frac{X}{C}\right)$

| | |
|---|---|
| **Signal Input:** | Any voltage or resistance range |
| **Reference Value:** | Any previous voltage or resistance reading or any number between ± .000001E-9 and ± 9999.99E+9 stored in memory C |
| **Accuracy:** | ± (accuracy of x reading ± 1 digit of displayed answer)*<br>*assumes no error of "C" value |
| **Reading Speed:** | Same as function selected plus 35 mS per reading calculation time |

## AUTOMATIC SOFTWARE RATIO $\frac{V1}{V2}$

| | |
|---|---|
| **Signal Input (V1):** | Front input terminals* |
| **Reference Input (V2):** | Rear input terminals* |
| **Normal Mode Rejection:** | Same as for function selected for both signal (V1) and reference (V2) inputs |
| **Isolation:** | 1000 megohms between any front input terminal and any rear input terminal. Max 1000V DC or 1500 peak AC from any front input terminal to any rear input terminal. |

*Inputs may be reversed using front/rear input programming by keyboard and remotely

| | |
|---|---|
| **Signal Ranges:** | Same as selected function |
| **Reference Ranges:** | 1, 10, 100, 1000V DC<br>1, 10, 100, 1000 V AC |
| **Accuracy - DC/DC:** | |
| **Same Reference/ Signal Range:** | ± .001% Input ± $\left(.001\% \text{ Range } \frac{RR}{RI}\right)^*$ |
| **Different Signal/ Reference Range:** | |
| **≥ 1V Range:** | ± .001% Input ± $\left(.001\% \text{ FS } \frac{RR}{RI}\right)$ |
| **≤ 100 mV Range:** | ± .007% Input ± $\left(.01\% \text{ FS } \frac{RR}{RI}\right)$ |
| **Accuracy - AC/AC:** | |
| **Same Reference/ Signal Range and Frequency:** | 100 Hz - 20 KHz<br>± .06% Input ± $\left(.05\% \text{ FS } \frac{RR}{RI}\right)$<br>50 Hz - 50 KHz<br>± .1% Input ± $\left(.1\% \text{ FS } \frac{RR}{RI}\right)$ |
| **Accuracy - Mixed Functions:** | Signal function specification and reference function specification (with % of range multiplied by $\frac{RR}{RI}$) |
| **Speed:** | Approximately 1 second per reading + timeouts for signal/reference functions and ranges (Max timeout approx 500 mS) |

*RR = Ref. Range
RI = Ref. Input

## 4-WIRE HARDWARE RATIO (OPTIONS 11 & 34)

| | |
|---|---|
| **Signal Input:** | Any voltage or resistance range front or rear input terminals as selected |
| **Reference Input:** | Rear reference input terminals |

### DC REFERENCE (OPTION 34)

| | |
|---|---|
| **Readout:** | Signal Input ÷ Ref Input Ratios are displayed in scientific notation. |
| **Signal Ranges:** | Same as Selected Function |
| **Reference Polarity:** | Positive Only |
| **Signal Polarity:** | Bipolar |
| **Reference Voltage Range:** | +1V to +10.5V |
| **Reference Common Mode Voltage Range:** | Voltage between + Ref In and – Sig In less than ± 15V |
| **Maximum Signal Voltage:** | Same as Selected Function |

### AC REFERENCE (OPTION 11)

| | |
|---|---|
| **Readout:** | Signal input ÷ reference input Ratios are displayed in scientific notation. |
| **Reference Ranges:** | 1V, 10V, 100V, 1000V RMS |
| **Signal Ranges:** | Same as Selected Function |
| **Maximum Reference Voltage:** | 1000V RMS or 1500V Peak |
| **Maximum Signal Voltage:** | Same as Selected Function |
| **Reference Voltage Range:** | 10% of F.S. to 160% F.S. except 1000V Range which is 10% to 100% of F.S. |
| **Reference Input Impedance:** | Same as AC Option 10 |
| **Ratio Accuracy:** | (Accuracy of Function) + (Accuracy of Option 10) The sum multiplied by $\frac{\text{Reference Range}}{\text{Reference Input}}$ |
| **Frequency Range:** | 20 Hz to 10 KHz |
| **Reference Temperature Coefficient:** | ± (0.004% RDG + 0.005% F.S.)/°C |

## REMOTE PROGRAMMING (Option 55 GPIB)

| | |
|---|---|
| **Output Information:** | Numeric data, polarity, function, range, and special flags. |
| **Input Information:** | Functions, ranges, microprocessing functions. (Full control of all instrument capabilities.) |
| **Buss Compatibility:** | IEEE STD-488-1975 |

## ANALOG SIGNAL OUTPUT

Input scaled and buffered. DC voltage is available for driving a recorder or as an accurate voltage

## GENERAL

| | |
|---|---|
| **Conversion Technique:** | Delayed Dual Slope |
| **Signal Integration Time:** | Display / Time |
| (60 Hz Std) | 4 1/2 Digits 1.67 mS<br>5 1/2 Digits 16.67 mS<br>6 1/2 Digits 100 mS |
| **Ranging:** | Auto Ranging is Standard |
| **Common Mode Voltage:** | 1000V DC or Peak AC Guard to Case<br>350V Analog common to Case |
| **Display:** | 6 full decades plus overrange digit plus decimal point, function, and range annunciators. |
| **Overrange Indication:** | Maximum reading is 160000 or approx. 220000 on 10 mV range. "OL" is displayed. |
| **Power Requirement:** | 100, 120, 220 or 240<br>Selectable from Rear Panel<br>60 Hz standard<br>50 Hz available<br>75 watts |
| **Weight:** | 25 Pounds |
| **Dimensions:** | 3.5" x 16.75" x 18" |
| **Temperature Range:** | 0°C to 50°C operating<br>–40°C to +70°C storage |
| **Humidity, Operating:** | 75% RH 25°C to 40°C<br>50% RH 40°C to 50°C |
| **Fan:** | Yes |
| **Vibration, Operating:** | 0.025" double amplitude to 50 Hz for 15 minutes |
| **Full Scale (F.S.):** | Defined as 100000 any Range |

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